Polar Equipment, Inc. – Polar Pure Water Disinfectant

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Device Information

The Polar Equipment, Inc., Polar Pure Water Disinfectant is a small specially designed glass bottle containing crystalline iodine. The bottle contains a trap in the neck to prevent iodine crystal loss during use. The user fills the bottle with water (raw, untreated water is acceptable), which dissolves a small amount of crystals, creating a 300 mg/L iodine solution at room temperature (20º C). Iodine solubility, and therefore solution concentration, increases with increasing temperature and this affects dose (e.g., 3º C = 200 mg/L, 40º C = 400 mg/L). After the required 1-hour wait time for the solution inside the bottle to equilibrate, the user observes the thermometer on the outside of the bottle, and based on the location of the green dot, the corresponding dose, in bottle capfuls, is poured from the bottle into a user supplied 1 L vessel containing untreated water. This creates a 4 mg/L iodine residual concentration. The manufacturer recommends that the dose be doubled if the untreated water is cloudy. Directions indicate that a 20-minute wait time is required prior to consumption. For effectiveness against *Giardia* cysts, the directions indicate the water being treated must be warmed to 20^{o} C by warming in the sun or adding hot water. The bottle containing the iodine crystals should be refilled with water so that the solution is ready for next use after a minimum wait of 1 hour. The device should not be frozen.

Effectiveness Against Microbial Pathogens

No data was received showing the effectiveness of this product with respect to the U.S. Environmental Protection Agency (USEPA) Guide Standard and Protocol for Testing Microbiological Water Purifiers (reference 1). Extensive research on iodine water disinfection can be found in literature and is summarized in reference 2. There is also some device-specific data that did not use the reference 1 protocol (reference 3). In the absence of data specific to this device tested using reference 1, and in accordance with other device-specific test data and available research, this device should be capable of consistently reducing bacteria (6-log) and viruses (4-log) to the required minimum log reductions stated in reference 1 under most water quality conditions when used as directed. It is not expected to consistently reduce *Giardia* cysts to the required 3-log reduction when used as directed. When used as directed, Polar Pure provides a disinfectant concentration times contact time (CT) of 80 mg-min/L for clear, warm waters and 160 mg-min/L for cloudy, warm waters. Polar Pure is capable of consistently achieving adequate *Giardia* cyst log reductions if increased dosages and/or longer contact time (wait time) beyond manufacturer's directions are used. To ensure adequate reduction of *Giardia* cysts in all water quality conditions, it is recommended that wait time be increased to at least

90-120 minutes and dosage doubled to provide a dose of 8 mg/L. This results in CT of 720-960 mg-min/L. Iodine has not been shown to be effective against *Cryptosporidium* oocysts. Based on general iodine disinfection studies and the limited device-specific testing data, the Polar Pure Water Disinfectant is given one √ each for bacteria and viruses, and an X for *Giardia* cysts and *Cryptosporidium* oocysts (for an explanation of the rating checks click here). The following table summarizes Polar Pure's expected performance, evaluation rating, and the mechanism by which pathogens are reduced:

Table. Expected Performance Against Microbial Pathogens When Used as Directed.

Microbial Pathogen Type	Expected Performance	Evaluation Rating	Inactivation/removal Mechanism
Bacteria	> 6-log	√	disinfection
Viruses	> 4-log	√	disinfection
Giardia cysts	Not Effective*	X*	-
Cryptosporidium oocysts	Not Effective	X	-

*Recommend doubling dosage (8 mg/L) and increasing wait time to 90-120 minutes to ensure adequate *Giardia* cyst reduction.

Production Capacity

According to manufacturer instructions, this device is capable of treating up to 2000 liters of water depending on water quality. After a 1-hour wait to allow the solution to saturate with iodine, plus the required wait time once dosed, one full bottle of saturated iodine solution can treat 2 - 6 L depending on water conditions.

Cleaning, Replacement, and End of Life Indicator, Shelf Life

No cleaning is required. If iodine crystals are visible in the bottle, the iodine solution will be produced in accordance with the manufacturer instructions. Once the iodine crystals are no longer visible, the bottle should be discarded. The manufacturer states an indefinite shelf life.

Weight and Size

The dry weight of the device is 90 grams. The bottle is about 8 cm in height and 5 cm in diameter.

Cost

This device costs about $10.00.

Device Evaluation

No data was received that challenged the Polar Equipment, Inc., Polar Pure Water Disinfectant against reference 1. Research conducted on iodine disinfection indicates that this device should be capable of consistently reducing bacteria and viruses when used as directed. This device is not capable of consistently reducing *Giardia* cysts and *Cryptosporidium* oocysts when used as directed. Increasing dosage to 8 mg/L and increasing wait time to at least 90-120 minutes should ensure adequate reduction of *Giardia* cysts for most water quality conditions expected. Additional treatment such as a 1 µm absolute filter is necessary to reduce *Cryptosporidium* oocysts. Both water temperature and cloudiness (turbidity) can't often be measured in the field and requires user subjectivity. In these situations, a conservative approach is recommended and treating water using recommended increased wait time and dosage should adequately protect the soldier from bacteria, viruses, and *Giardia* cysts. Polar Pure is not expected to cause any adverse health effects when used as directed by healthy adults with no pre-existing thyroid conditions or sensitivity to iodine. There is concern to healthy individuals if the iodine crystals are poured into the water being treated. Consuming treated water containing iodine crystals could potentially expose the user to extremely high iodine concentrations that may be harmful to healthy adults. Polar Pure is not recommended for use by pregnant women (concern for fetus), people with known hypersensitivity to iodine, people with a history (or family history) of thyroid disease, and people from areas with chronic iodine deficiency (reference 2). Use of this device may impart a medicinal taste and color the water. The iodine can be neutralized by adding ascorbic acid (Vitamin C) or sodium thiosulfate, which will improve the taste and color. Flavored drink mixes can mask the flavor. Neutralizers and flavor aids should only be added after the recommended wait times are reached. Use of this device will not reduce or remove particulate matter.

Advantages

- Although device-specific testing data using the USEPA protocol is not available, Polar Pure is expected to consistently provide adequate protection from bacteria and viruses when used as directed.
- Very small and lightweight device capable of treating up to 2000 L.

- Simple and inexpensive to use.
- No adverse health effects expected in healthy adults with no iodine sensitivity.

Disadvantages

- Not effective against *Cryptosporidium* oocysts. Additional treatment is necessary.
- Not consistently effective against *Giardia* cysts. Recommend increased wait times (90-120 minutes) and dosage (8 mg/L) to provide adequate protection from *Giardia* cysts.
- Not recommended for use by pregnant women or people with iodine sensitivity.
- Does not remove or reduce particulate matter and can impart color and medicinal taste.
- Requires user subjectivity with respect to evaluating cloudiness (turbidity) and temperature.

References

1. USEPA, 1989. Guide Standard and Protocol for Testing Microbiological Water Purifiers. *Federal Register*. 54:34067.

2. U.S. Army Center for Health Promotion and Preventive Medicine. (2005). *Technical Information Paper; Iodine Disinfection in the Use of Individual Water Purification Devices,* Aberdeen Proving Ground, MD.

3. Ongerth, J.E. et. al. (1989). Backcountry Water Treatment to Prevent Giardiasis. *American Journal of Public Health*, 79(12), 1633-1637.